US 20120130410A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2012/0130410 A1**

(43) **Pub. Date: May 24, 2012**

Tal et al.

(54) **DIRECTION REVERSING VASCULAR TREATMENT DEVICE**

(75) Inventors: **Michael G. Tal**, Woodbridge, CT (US); **John P. Marano**, Madison, CT (US)

(73) Assignee: **Vascular Insights LLC**, Madison, CT (US)

(21) Appl. No.: **13/295,495**

(22) Filed: **Nov. 14, 2011**

Related U.S. Application Data

(60) Provisional application No. 61/413,895, filed on Nov. 15, 2010.

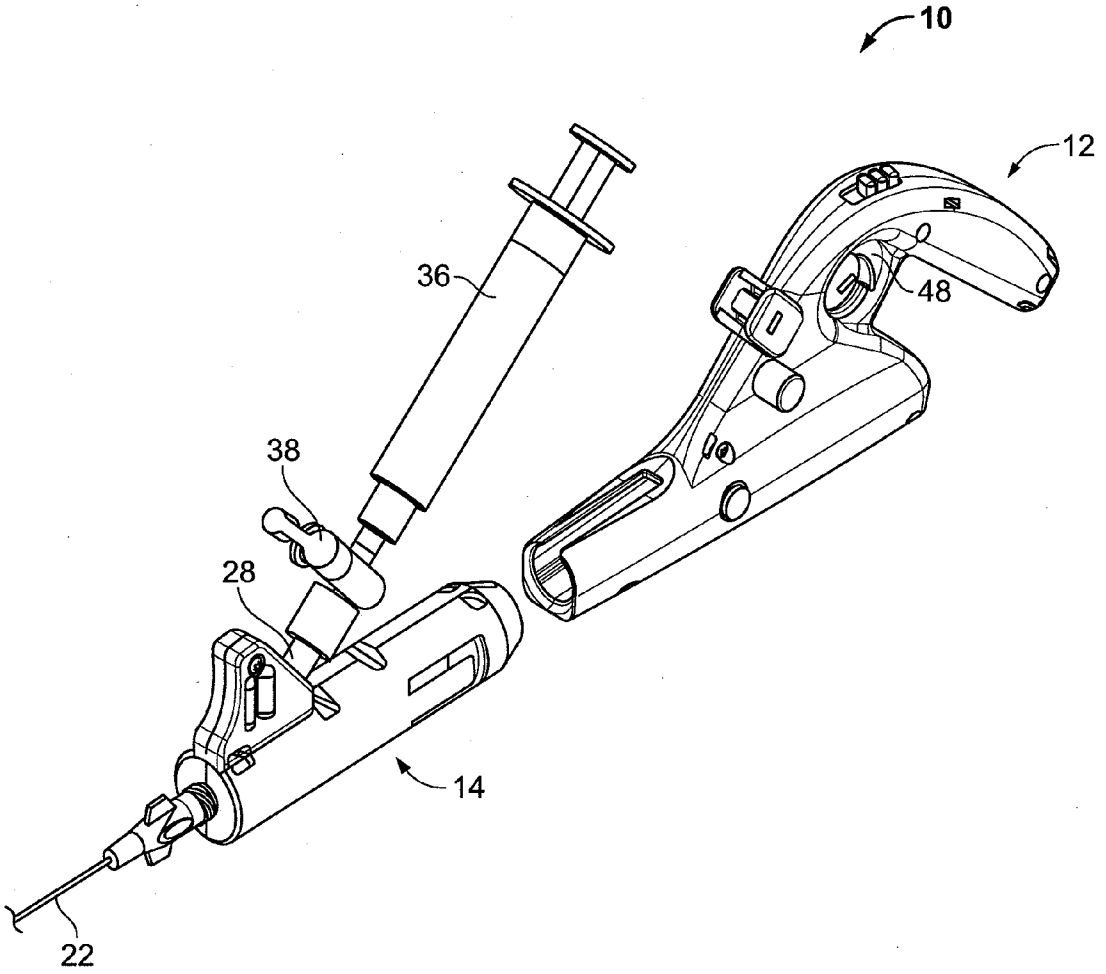
Publication Classification

(51) **Int. Cl.**
A61B 17/22 (2006.01)

(52) **U.S. Cl.** **606/159**

(57) **ABSTRACT**

An apparatus for performing a vascular treatment includes an intraluminal member that is controllingly moved during the vascular treatment. The intraluminal member of the vascular treatment device can be connected to a motor. The rotation direction of the intraluminal member can be reversed to reduce the incidence and duration of vein entanglement during a vascular ablation procedure. Reversal of direction could occur automatically, or in response to a sensor such as a load sensor provided as part of the motorized drive system.



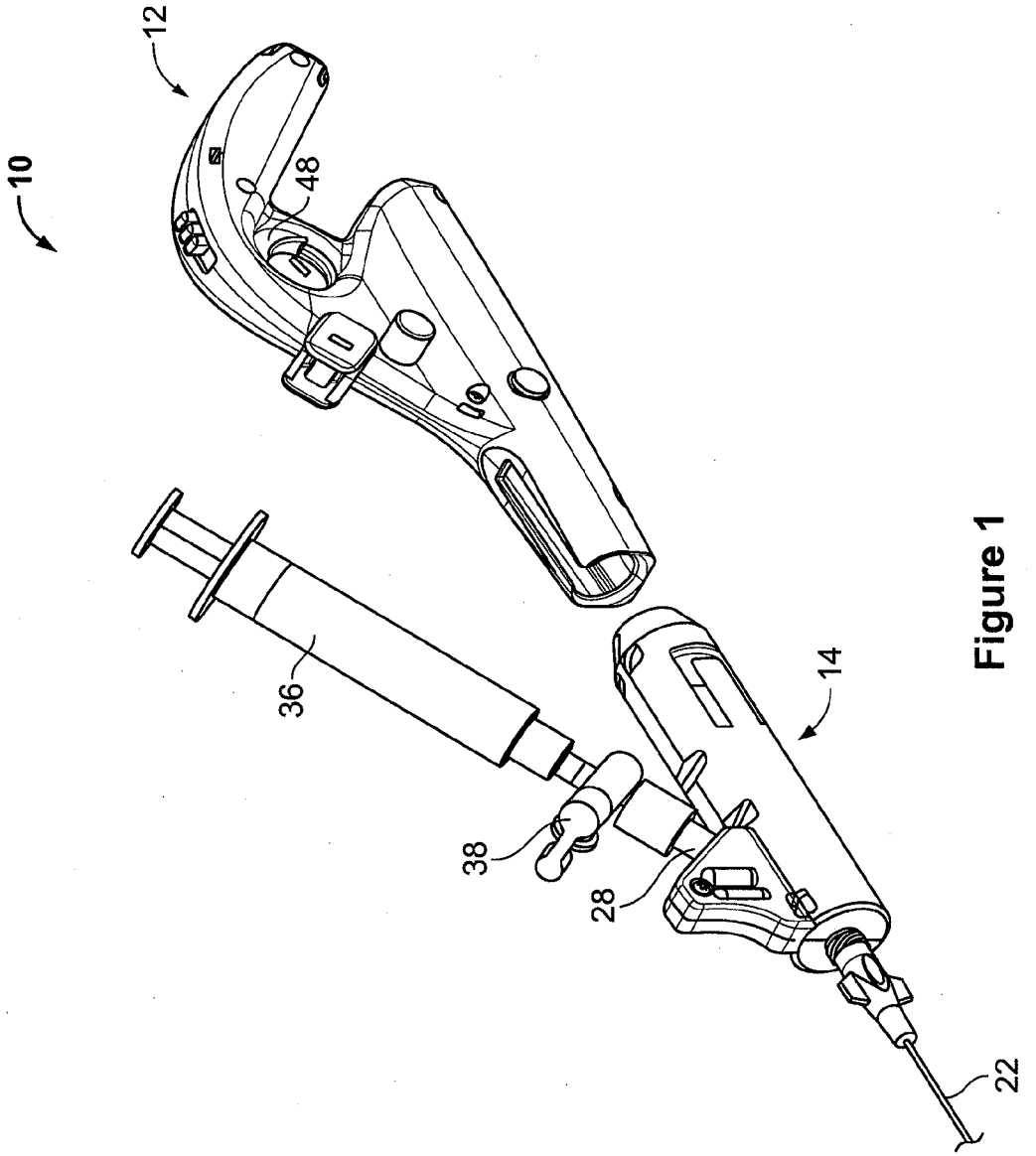


Figure 1

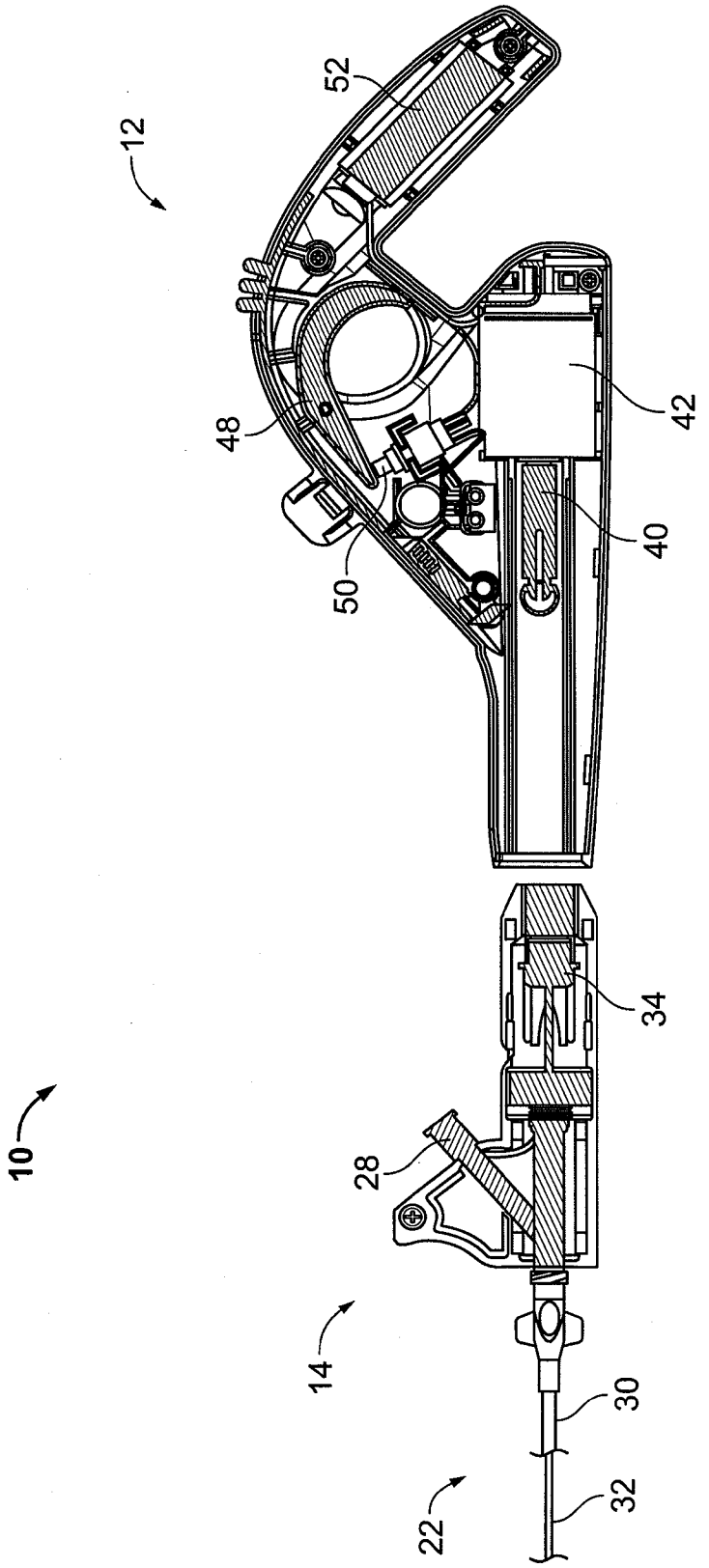


Figure 2A

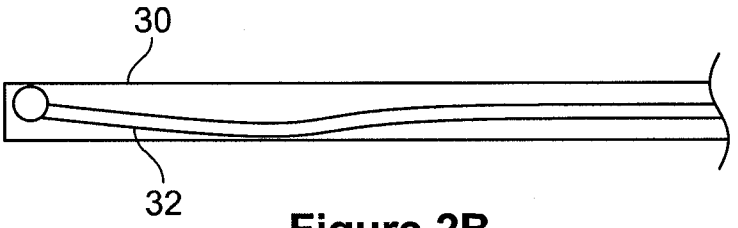


Figure 2B

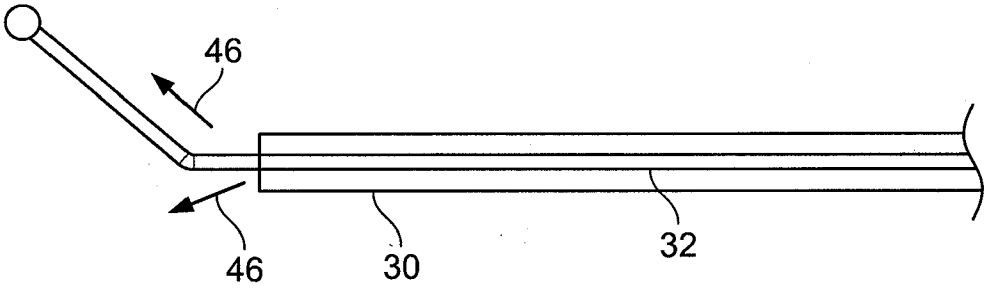


Figure 2C

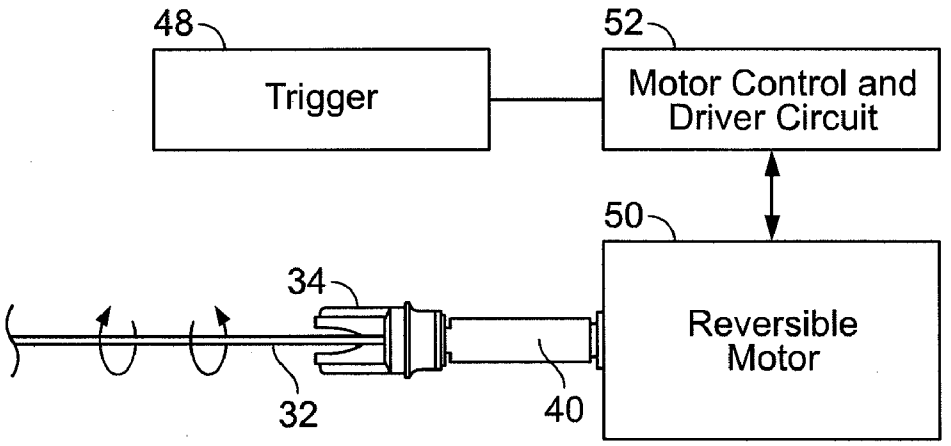


Figure 3

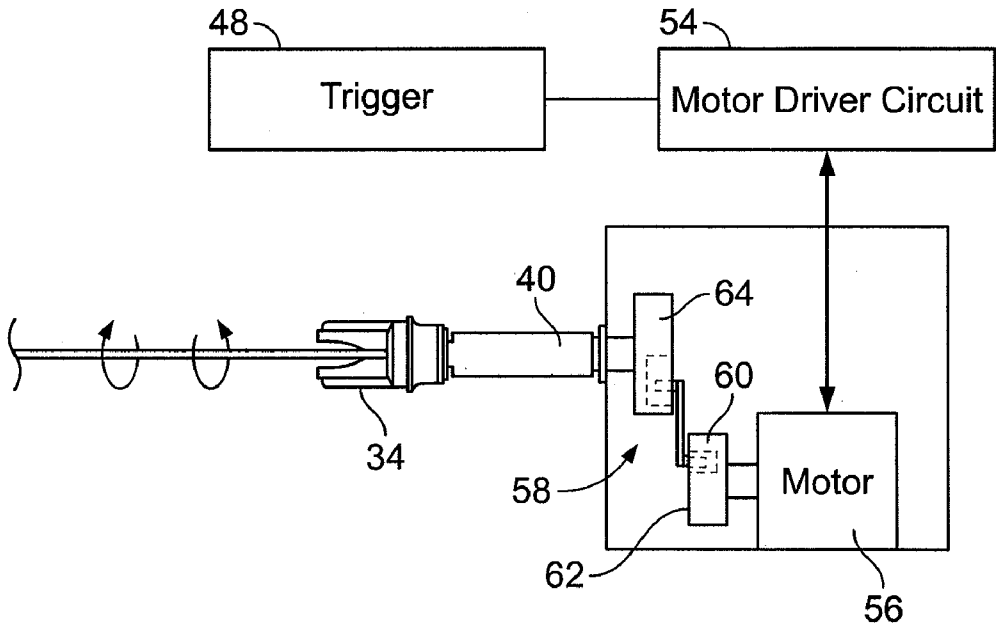


Figure 4

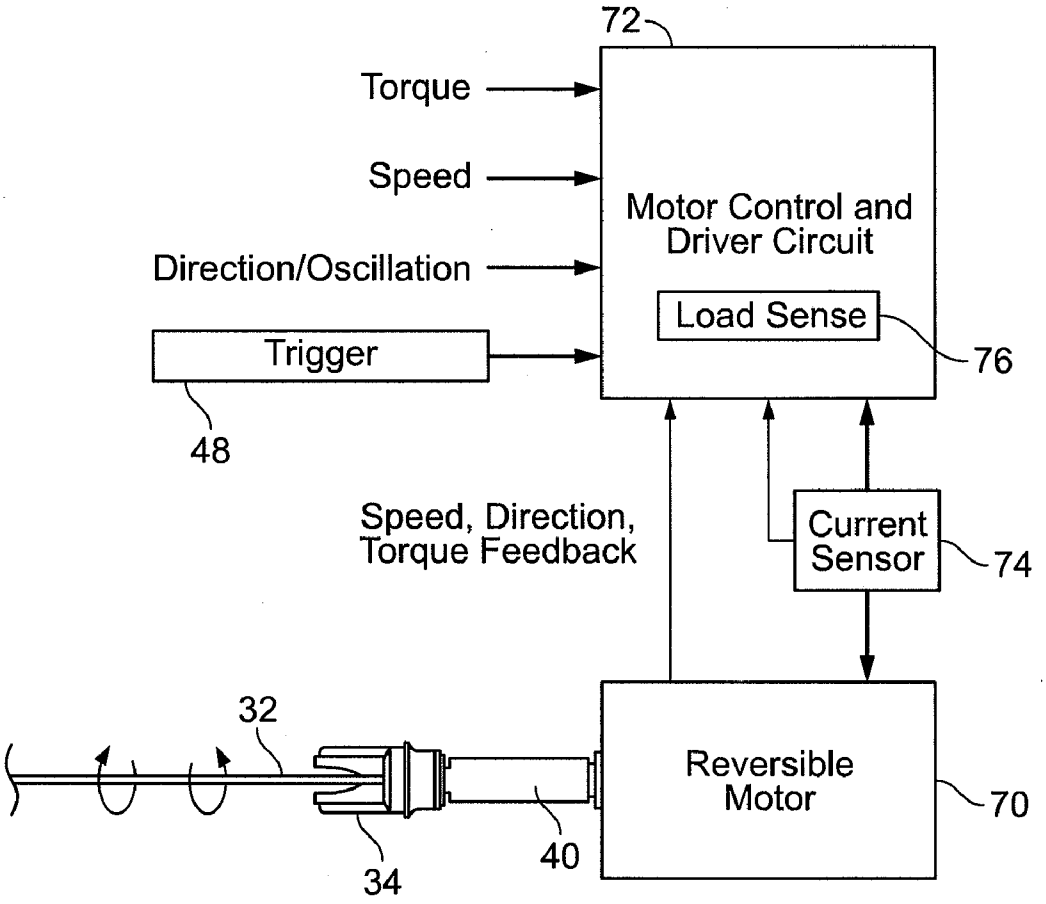

72
Torque
Speed
Direction/Oscillation
Trigger
48
Motor Control and
Driver Circuit
Load Sense
76
Speed, Direction,
Torque Feedback
Current
Sensor
74
32
34
40
Reversible
Motor
70

Figure 5

DIRECTION REVERSING VASCULAR TREATMENT DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/413,895, filed on Nov. 15, 2010, the disclosure of which is hereby incorporated by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] This specification relates to the field of vascular treatment.

[0004] 2. Description of the Related Art

[0005] Sclerotherapy can be used to treat blood vessels, blood vessel malformations, and similar problems in other body systems, such as the lymphatic system, and has been used in various forms for over 150 years. In its more modern form, sclerotherapy has been used since the 1960's, in Europe, for treating various vein conditions such as; varicose veins, reticular veins, spider veins of the leg, and also some fine facial veins.

[0006] Sclerotherapy can be used to treat these conditions by instigating vascular fibrosis and obliteration in response to irreversible endothelial cellular destruction and exposure of the underlying subendothelial cell layer. This destruction is usually caused by the injection of a sclerosant into the vein. However, if the injected sclerosant is too weak, there may be no endothelial injury at all. If the sclerosant is a little stronger, the varicose vessel is damaged, but recanalization occurs and an incompetent pathway for retrograde blood flow persists. Finally, if the injected sclerosant is too strong, the varicose vessel endothelium is destroyed, but adjacent vessels that are not targeted for treatment may also be damaged by the sclerosant.

[0007] The requirement for an ideal strength of the sclerosant is complicated by the constant flow of blood through the vein that is being treated. This flow simultaneously dilutes, and thereby weakens, the sclerosant, while also transporting the sclerosant to other parts of the vascular system.

[0008] Thus, improved methods and devices for treating the vascular system are desired.

SUMMARY OF THE INVENTION

[0009] Some embodiments relate to a vascular treatment apparatus. The apparatus can include, for example, an elongated intraluminal member shaped and dimensioned for passage through blood vessels of a subject. The intraluminal member can include, for example, a proximal end and a distal end. The apparatus can further include a motorized drive system coupled to the intraluminal member. The motorized drive system can, in some embodiments, reverse the direction of rotation of the intraluminal member.

[0010] In some embodiments of the apparatus, the motorized drive system can be, for example, a reversible motor, a kinematic chain, or a gearbox. In some embodiments of the apparatus, the motorized drive system can rotationally oscillate the intraluminal member. In some embodiments, the motorized drive system can oscillate the intraluminal member in a manner configured to inhibit entanglement of the intraluminal member with the vein, or can reverse the direction of rotation when a load threshold is reached or exceeded.

[0011] Some embodiments relate to a method for vascular treatment. The method can include, for example, advancing an elongated intraluminal member from an access site and into the vein. The method may comprise rotating the intraluminal member or portion thereof in a first direction, and reversing the direction of rotation of the intraluminal member or portion thereof. In some embodiments of the method, the reversal of a direction of rotation occurs when a threshold load is met or exceeded. The rotation reversal can, for example, inhibit entanglement of the intraluminal member with the vein.

[0012] In another embodiment, a vascular treatment apparatus comprises an elongated intraluminal member shaped and dimensioned for passage through blood vessels of a subject, the intraluminal member including a proximal end and a distal end. At least a first motor is coupled to the intraluminal member to move the intraluminal member, a motor drive circuit is coupled to the motor; and a load sensor is coupled to the motor drive circuit. The motor drive circuit may stop or reverse direction of the motor in response to a sensed load.

[0013] In one specific application, the apparatus and methods may be applied to permanently occluding veins. In these embodiments, the intraluminal member may have a portion that can produce damage to the inner vein wall. The apparatus may further comprise a source of sclerosant and a fluid channel between the source of sclerosant and the distal end of the elongated intraluminal member.

[0014] The foregoing is a summary and thus contains, by necessity, simplifications, generalization, and omissions of detail; consequently, those skilled in the art will appreciate that the summary is illustrative only and is not intended to be in any way limiting. Other aspects, features, and advantages of the devices and/or processes and/or other subject matter described herein will become apparent in the teachings set forth herein. The summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. **1** shows an embodiment of an assembly of a vascular treatment device.

[0016] FIG. **2**A illustrates a longitudinal cross-sectional view of the embodiment illustrated in FIG. **1**.

[0017] FIG. **2**B illustrates the distal ends of the wire and sheath of FIG. **2**A with the distal end of the wire within the sheath.

[0018] FIG. **2**C illustrates the distal ends of the wire and sheath of FIG. **2**A with the distal end of the wire extending out from the end of the sheath.

[0019] FIG. **3** shows a schematic view of a motion system for a vascular treatment device that incorporates a reversible motor.

[0020] FIG. **4** shows a schematic view of a motion system for a vascular treatment device that incorporates an oscillating gear system.

[0021] FIG. **5** shows a schematic view of a motion system for a vascular treatment device that incorporates a reversible motor with load sensing and additional control functions.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] The following description and examples illustrate preferred embodiments of the present invention in detail.

Those of skill in the art will recognize that there are numerous variations and modifications of this invention that are encompassed by its scope. Accordingly, the description of a preferred embodiment should not be deemed to limit the scope of the present invention. In this description, reference is made to the drawings wherein like parts are designated with like numerals throughout.

[0023] FIG. **1** depicts a perspective view of one embodiment of exemplary components of a vascular treatment device **10**. These components can be configured to provide a range of functionalities to the vascular treatment device **10**. In some embodiments, a vascular treatment device **10** can include features configured for stimulating vascular ablation, such as, for example, an intraluminal member **22**, a motorized drive system, including, for example, a motor, and/or control features and/or features configured for delivering liquid sclerosant. In some embodiments described further below, the intraluminal member comprises a wire surrounded by a sheath, and the wire is rotatable within the sheath. The space between the sheath and the wire can be used as a passage to inject sclerosant as the wire rotates, and the distal end of the wire forms a vein wall disruptor.

[0024] In general, the vascular treatment device **10** of FIG. **1** is utilized by introducing the intraluminal member into a vein of a subject, where the vein is to be ablated in a treatment for varicose veins for example. The distal end of the wire is extended from the distal end of the sheath, and the wire is rotated or otherwise moved to damage the endothelium lining the inside surface of the vein. Sclerosant is also injected to the region of damage through the sheath that forms an outer portion of the intraluminal member **22**. The combination of endothelium damage plus the sclerosant provides a highly effective vascular ablation procedure with a minimum amount of injected sclerosant.

[0025] As depicted in FIG. **1**, a vascular treatment device can include a handle **12** and a cartridge **14**. As explained below in greater detail, each of the handle **12** and cartridge **14** can include features configured for stimulating vascular ablation and/or for delivering liquid sclerosant. In one embodiment, and as depicted in FIG. **1**, the handle **12** and the cartridge **14** can comprise separate pieces. In another embodiment, a handle **12** and a cartridge **14** can comprise an integrated component. A person of skill in the art will recognize that the present disclosure is not limited to a specific configuration of the handle **12** and cartridge **14** but broadly includes the range of functions and uses of a vascular therapy device.

[0026] As further depicted in FIG. **1**, the cartridge **14** can be, for example, sized and shaped to engagingly connect to the handle **12**. In one embodiment, and as shown in FIG. **1**, this engaging connection can be achieved by fitting features of the handle **12** to features of the cartridge **14**.

[0027] FIG. **2** depicts a side cross-section view of the vascular treatment device **10** of FIG. **1**. The vascular treatment device **10** depicted in FIG. **2** comprises the same features discussed in relation to FIG. **1**. Referring now to both FIGS. **1** and **2**, the cartridge **14** may include a sheath **30** affixed to and extending from the cartridge **14**, a wire **32**, and a coupling **34**. The wire **32** can be, for example, fixed to the coupling **34**. A person of skill in the art will recognize that the wire **32** can be affixed to the coupling **34** through a variety of techniques and methods. A person of skill in the art will further recognize that the wire **32** can be affixed to a range of features of a vascular treatment device **10** configured for driving the wire **32**.

[0028] The wire **32** (and surrounding sheath) can comprise a variety of lengths. In some embodiments, a wire **32** can have a length matching the needs of the procedure. In some embodiments, a wire **32** can have a length, for example, of up to 10 cm, up to 25 cm, up to 75 cm, or up to 150 cm.

[0029] The sheath **30** can be configured to define a lumen through which the wire **32** runs, and can be configured to allow independent motion of the wire within the sheath. The sheath **30** can have a variety of inner and outer diameters. In some embodiments, the sheath **30** can have an inner diameter ranging from approximately 0.022 inches to 0.048 inches. In some embodiments, the sheath **30** can have an outer diameter ranging from approximately 0.025 inches to 0.051 inches. In some embodiments, the outer diameter of the sheath **30** can be in the range that is, for example, consistent with the inner diameter of standard needles or vascular sheaths used for used for insertion of vascular catheters.

[0030] The sheath **30** may also include external markings at regular intervals which may guide the user to monitor the insertion or removal speed of the intraluminal member **22**.

[0031] Some embodiments of a vascular treatment device **10** can be configured for use with injectant. In some embodiments, the cartridge **14** can be configured for holding an injectant such as sclerosant in a syringe **36** attached to the cartridge **14** at a coupler **28**. Some embodiments of a vascular treatment device **10** and/or a cartridge **14** configured for use in connection with an injectant can be, for example, configured with valves and connectors to facilitate such use. In some embodiments, a syringe **36** can, for example, connect to a stopcock **38** on a cartridge **14**. The stopcock **38** shown in FIG. **2** can be configured to allow the removal and/or attachment of a syringe to the vascular treatment device **10** during a procedure. In some embodiments, a stopcock **38** can be configured to allow reloading of fluid and/or exchanging of containers to, for example, change the injectant or the concentration of the injectant. In some embodiments, the stopcock **38** can be configured to provide additional functionality, such as, for example, mixing or aerating the injectant. The output of the coupler **28** is in fluid communication with the space between the sheath **30** and the wire **32** so that the injectant can be pushed along this space to the distal end of the wire and sheath where the injectant (e.g. sclerosant) exits the sheath when installed in the vein.

[0032] In use, the sheath **30** with the wire **32** inside may be introduced into the vein prior to coupling the cartridge **14** to the handle **12**. At this time, the wire **32** may be fully enclosed by the sheath **30** as shown in FIG. **2**B. After introduction, the cartridge **14** can be inserted into the handle **12**, and the coupler **34** can engage a mating coupler **40** in the handle. The coupler **34** in the cartridge which is attached to the wire **32** may be slidable within the cartridge **14**, so that when the coupler **34** in the cartridge is forced into engagement with the coupler **40**, the distal end of the wire **32** is pushed out of the sheath **30**, as shown in FIG. **2**C. This exposes a portion of the wire **32** that is configured to damage the endothelium on the inner surface of the vein. The coupler **40** in the handle **12** is attached to the shaft of a motor **42** in the handle that may rotate the coupler **40**, mated coupler **34**, and attached wire **32** to scrape and damage the inner wall of the vein. During this process, sclerosant may be forced down the sheath, to exit the

sheath in the region near the distal end of the wire **32**, as shown by arrows **46** in FIG. **2**C.

[0033] Motor rotation may be controlled by a trigger **48** in the handle that depresses and releases a switch **50** to start and stop motor rotation. The handle **12** may further include a power source for the motor such as battery **52**. Embodiments of vascular treatment devices such as illustrated in FIGS. **1** through **2**C are further described in U.S. Pat. Nos. 7,862,575 and 7,967,834 which are incorporated herein by reference in their entireties.

[0034] Although vascular ablation treatments using the above described vascular treatment device have shown dramatic improvement over prior vascular ablation methods, it has been found that the drive system illustrated in FIG. **2**A is sometimes not optimal. For example, the distal end of the wire **32** can sometimes catch on the inner vein wall, twisting the vein and entangling the wire and the vein. When this occurs, the operator of the device may need to stop the procedure to release the wire from the vein. This issue may be caused by insufficient control or variation of motor motion during the procedure, a problem that is addressed by the embodiments described below with respect to FIGS. **3**, **4**, and **5**.

[0035] FIG. **3** illustrates one embodiment of a wire **32** drive system that helps resolve these problems. In FIGS. **3**, **4**, and **5**, many components of the cartridge **14** and handle **12** are omitted for clarity, focusing only on the drive system for wire **32**. Couplers **34** and **40** are shown. In the embodiment of FIG. **3**, a motor **50** used to drive the wire **32** is a reversible motor. The motor **50** is controlled by a motor control and driver circuit **52** that is configured to periodically change the direction of rotation of the wire **32**. Such a change in direction can be performed at defined time intervals such as one a second, ten times a second, etc., or the change in direction can be performed after a set number of rotations such as every five rotations, or with every rotation, or with fractions of a rotation if desired. Random or pseudo-random timing of rotation changes is also possible. Thus, a variety of rotational oscillation motions can be programmed or hard wired into the motor control and driver circuit **52**. Such motors and motor control circuits are well known and commercially available, and can be used in place of the motor **42** and single direction rotation of FIG. **2**. With these direction rotations, entanglement with the vein is less likely, and if it does occur, the next direction reversal is likely to free the wire from the vein.

[0036] FIG. **4** depicts a motorized drive system comprising a trigger **48**, a motor driver circuit **54**, a motor **56**, and a kinematic chain **58** connecting the motor **56** to the coupler **40**. The kinematic chain **58** can comprise, for example, an assemblage of links and joints interconnected so as to provide a desired output in response to desired input. In some embodiments, the kinematic chain **58** can comprise one or several gears, one or several rigid linked members, one or several flexible linked members, or any other desired feature. In some embodiments, the kinematic chain **58** can be configured to translate a single direction motor **56** output into rotational oscillation of the wire **32**.

[0037] FIG. **4** depicts one specific kinematic chain **58** comprising a first wheel **60**, a link **62**, and a second wheel **64**. In some embodiments, the motor **56** can rotate the first wheel **60** about the axis of the motor driven shaft. A first end of the link **62** can be rotationally connected to a portion of the first wheel **60**, and a second end of the link **62** can be rotationally and slidingly connected with a portion of the second wheel **64**. The combination of the rotational connection of the first end of the link **62** to the first wheel **60**, and the rotational and sliding connection of the second end of the link **62** to the second wheel **64** can allow conversion of the single direction rotational input of the driven shaft of the motor to rotationally oscillating output of the motorized drive system output. Although one specific kinematic chain **58** is described herein, a person of skill in the art will recognize that a variety of kinematic chains can be used in connection with the motorized drive system to achieve the desired movement of the wire **32**. The motorized drive system of FIG. **4** utilizes a simpler and less expensive motor and motor drive circuit compared to the system of FIG. **3**, with the addition of the mechanical components of the kinematic chain **58**.

[0038] FIG. **5** depicts a motorized drive system comprising a trigger **48**, a motor control and driver circuit **72**, and a reversible motor **70**. In addition to these features, FIG. **5** depicts a load sensor **76** that may be incorporated into the motor control and driver circuit **72**. The load sensor **76** can be configured to detect the motor load based on inputs from an output current sensor **74** that senses the current being used to drive the motor and/or other sensor signals such as speed and torque signals that may be routed to the motor control and drive circuit **72** from sensors integral to the motor **70**. For example, the load sensor may determine that the current to the motor has exceeded a threshold, that the torque output has exceeded a threshold, or that the speed of rotation has slowed below a threshold. It will be appreciated that the load sensor, **76**, current sensor **74** or other motor parameter sensors can be incorporated into the motor **70**, the motor control and driver circuit **72**, be standalone components, or have portions thereof distributed in any of these or other locations. The load sensor **76** can comprise software, hardware, or a combination of hardware and software.

[0039] The motor control and driver circuit **72** can be configured to control the motor based in part on signals generated by the motor load sensor **76**. In some embodiments, the motor control and driver circuit **72** may speed up the rotation rate of the motor **70**, slow down the rotation rate of the motor **70**, or reverse the direction of rotation of the motor **70** in response to signals generated by the motor load sensor **76**. In one embodiment, the motor control and driver circuit **72** can be configured to reverse the direction of rotation of the motor **72** when the motor load sensor **76** detects a motor load which meets or exceeds a load threshold. In some embodiments, this load threshold can, for example, correspond to a condition with the treated vessel, such as, for example, entanglement of the wire **32** in vein tissue, over penetration of the wire **32** into vein tissue, or other conditions. Advantageously, the reversing of the direction of rotation of the motor **70**, and thereby reversing the direction of rotation of the wire **32** can minimize the severity and duration of, and/or prevent entanglement of the wire **32** with the vein.

[0040] In some embodiments, the motor control and driver circuit **72** is user programmable with a variety of motor control options. The user may, for example, be able to select a rotation speed, a desired torque value or torque limit during the procedure, the direction of rotation, and whether and how quickly the wire should oscillate back and forth with reversing rotations or rotate in one direction only. The motorized drive system can, for example, be programmable to rotate the wire **32** at any rate between approximately 500 to 5,000 rpm, and reverse direction at any rate between every half rotation to every 500 rotations.

[0041] The device could include switches or a keypad for such programmable control, or may have an input/output port for interfacing to a computer for download of configuration choices. The behavior of the motor control and driver circuit **72** in response to sensor inputs related to load, speed, etc. could also be programmable, or may be fixed at manufacture.

[0042] The foregoing description details certain embodiments of the devices and methods disclosed herein. It will be appreciated, however, that no matter how detailed the foregoing appears in text, the devices and methods can be practiced in many ways. As is also stated above, it should be noted that the use of particular terminology when describing certain features or aspects of the invention should not be taken to imply that the terminology is being re-defined herein to be restricted to including any specific characteristics of the features or aspects of the technology with which that terminology is associated. Furthermore, although the above description has focused on the application of the principles discussed to vein ablation procedures, the features set forth above could be applied to a variety of vascular treatments.

[0043] It will be appreciated by those skilled in the art that various modifications and changes may be made without departing from the scope of the described technology. Such modifications and changes are intended to fall within the scope of the embodiments. It will also be appreciated by those of skill in the art that parts included in one embodiment are interchangeable with other embodiments; one or more parts from a depicted embodiment can be included with other depicted embodiments in any combination. For example, any of the various components described herein and/or depicted in the Figures may be combined, interchanged or excluded from other embodiments.

[0044] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0045] It will be understood by those within the art that, in general, terms used herein are generally intended as "open" terms (e.g., the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to embodiments containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (e.g., "a" and/or "an" should typically be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should typically be interpreted to mean at least the recited number (e.g., the bare recitation of "two recitations," without other modifiers, typically means at least two recitations, or two or more recitations). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

[0046] All references cited herein are incorporated herein by reference in their entirety. To the extent publications and patents or patent applications incorporated by reference contradict the disclosure contained in the specification, the specification is intended to supersede and/or take precedence over any such contradictory material.

[0047] The term "comprising" as used herein is synonymous with "including," "containing," or "characterized by," and is inclusive or open-ended and does not exclude additional, unrecited elements or method steps.

What is claimed is:

1. A vascular treatment device, comprising:

an elongated intraluminal member shaped and dimensioned for passage through blood vessels of a subject, the intraluminal member including a proximal end and a distal end; and

a motorized drive system coupled to the intraluminal member, wherein the motorized drive system is configured to rotate the intraluminal member, and to reverse the direction of rotation of the intraluminal member.

2. The apparatus of claim **1**, wherein the drive system comprises a reversible motor.

3. The apparatus of claim **1**, wherein the drive system comprises a kinematic chain.

4. The apparatus of claim **1**, wherein the drive system comprises a gearbox.

5. The apparatus of claim **1**, where the motorized drive system is configured to rotationally oscillate the intraluminal member.

6. The apparatus of claim **5**, wherein the motorized drive system is configured to rotate the intraluminal member one rotation in each oscillation.

7. The apparatus of claim **2**, wherein the motorized drive system comprises a motor control and driver circuit configured to periodically reverse a rotation direction of the reversible motor.

8. The apparatus of claim **7**, wherein the motor control and driver circuit is programmable.

9. The apparatus of claim **1**, wherein the motorized drive system is configured to rotationally oscillate the intraluminal member in a manner configured to inhibit entanglement of the intraluminal member with the vein.

10. The apparatus of claim **1**, wherein the motorized drive system is configured to reverse the direction of rotation when a load threshold is reached or exceeded.

11. The apparatus of claim **1**, wherein the distal end of the intraluminal member comprises a vein wall disruptor.

12. The apparatus of claim **11**, comprising:

a source of sclerosant; and

a fluid channel between the source of sclerosant and the distal end of the intraluminal member.

13. A vascular treatment method comprising the following steps:

advancing an elongated intraluminal member from an access site and into a vein;

rotating the intraluminal member or portion thereof in a first direction;

reversing the direction of rotation of the intraluminal member or portion thereof.

14. The method of claim **13**, wherein the reversal of a direction of rotation occurs when a load threshold is met or exceeded.

15. The method of claim **13**, wherein the periodic reversal of the direction of rotation of the intraluminal member occurs for every full rotation of the intraluminal member or portion thereof.

16. The method of claim **13**, wherein the periodic reversal inhibits entanglement of the intraluminal member with the vein.

17. An apparatus for permanently occluding a vein, comprising:

an elongated intraluminal member shaped and dimensioned for passage through blood vessels of a subject, the intraluminal member including a proximal end and a distal end;

at least a first motor coupled to the intraluminal member to move the intraluminal member or portion thereof in a defined movement;

a motor drive circuit coupled to the motor; and

a load sensor coupled to the motor drive circuit.

18. The apparatus of claim **17**, wherein the motor drive circuit is configured to stop the motor in response to the load sensor.

19. The apparatus of claim **17**, wherein the motor drive circuit is configured to slow the motor in response to the load sensor.

20. The apparatus of claim **17**, wherein the motor drive circuit is configured to reverse the direction of the motor in response to the load sensor.

21. The apparatus of claim **17**, wherein the distal end of the elongated intraluminal member comprises a vein wall disruptor.

22. The apparatus of claim **21**, comprising:

a source of sclerosant; and

a fluid channel between the source of sclerosant and the distal end of the elongated intraluminal member.

23. A vascular treatment method comprising the following steps:

advancing an elongated intraluminal member from an access site and into a vein;

producing a defined movement of the intraluminal member or a portion thereof using a motor coupled to the intraluminal member;

detecting a load applied to the motor through the intraluminal member with a load sensor coupled to the motor drive circuit;

altering one or both of motor speed and direction based on load sensor output.

24. The method according to claim **23**, wherein the motor speed decreases in response to load sensor output.

25. The method according to claim **23**, wherein the motor stops in response to load sensor output.

26. The method according to claim **23**, wherein the motor speed increases in response to load sensor output.

27. The method according to claim **23**, wherein the direction of motor movement reverses in response to load sensor output.

28. An apparatus for permanently occluding a vein, comprising:

an elongated intraluminal member shaped and dimensioned for passage through blood vessels of a subject, the intraluminal member including a proximal end and a distal end; and

a motorized drive system coupled to the intraluminal member, wherein the motorized drive system is configured to rotate the intraluminal member or a portion thereof; and

means for reversing the direction of rotation of the intraluminal member or portion thereof.

29. The apparatus of claim **28**, wherein the means for reversing the direction of rotation comprises a motor control and driver circuit and a reversible motor.

30. The apparatus of claim **28**, wherein the means for reversing the direction of rotation comprises a kinematic chain.

31. The apparatus of claim **28**, wherein the distal end of the elongated intraluminal member comprises a vein wall disruptor.

32. The apparatus of claim **31**, comprising:

a source of sclerosant; and

a fluid channel between the source of sclerosant and the distal end of the elongated intraluminal member.

* * * * *